

HEWLETT  PACKARD

OPERATING AND SERVICE MANUAL

**TRACKING GENERATOR  
8444A  
INCLUDES OPTION 058**

**SERIAL NUMBERS**

This manual applies directly to instruments with serial numbers prefixed 1323A.

With modifications described in Section VII, this manual also applies to instruments with serial numbers prefixed 1033A, 1139A, 1147A, 1208A and 1215A.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

Valuetronics International, Inc.

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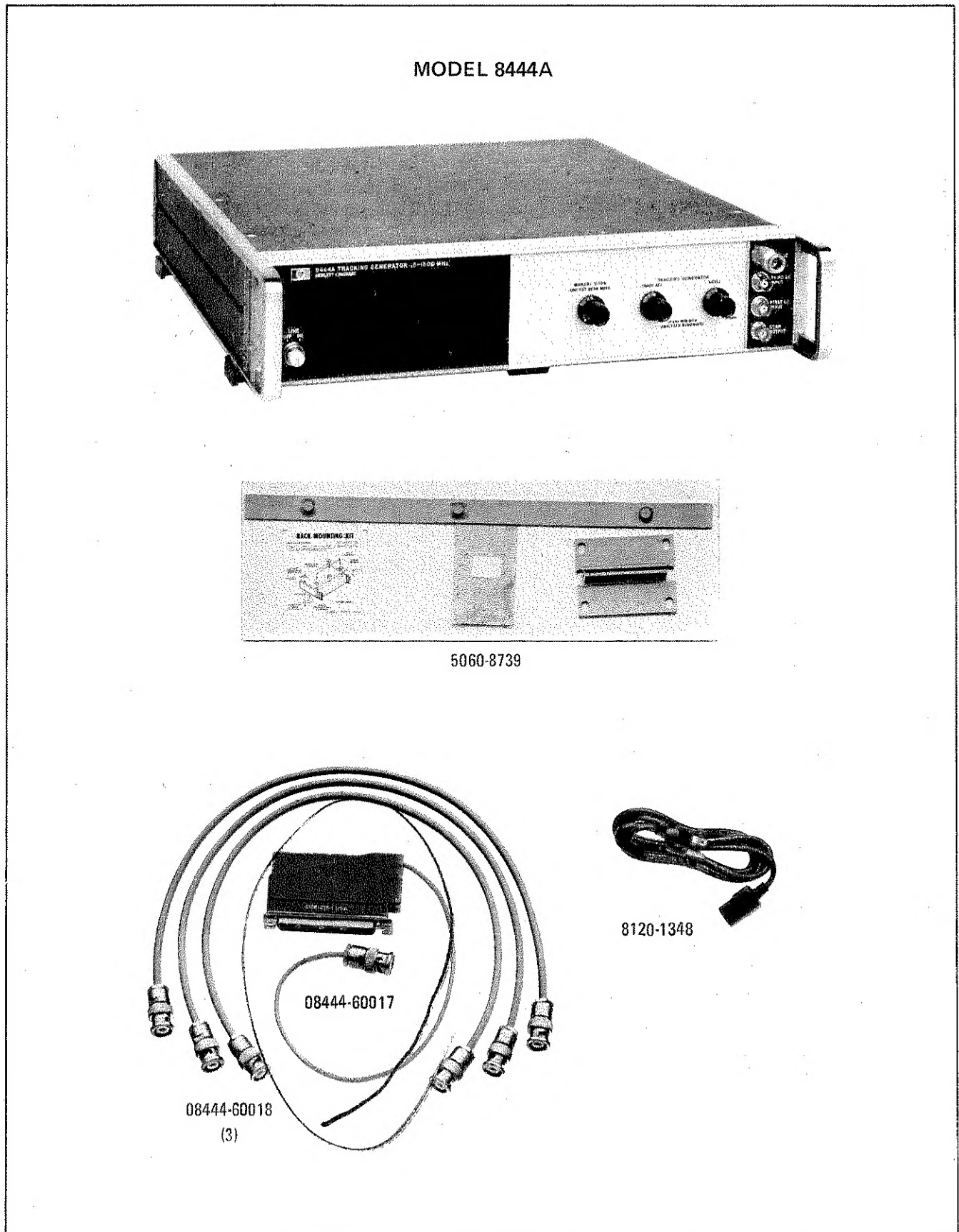


Figure 1-1. Model 8444A Tracking Generator and Accessories



## SECTION I GENERAL INFORMATION

### 1-1. INTRODUCTION

1-2. This manual contains all information required to install, operate, test, adjust and service the Hewlett-Packard Model 8444A Tracking Generator. This section covers instrument identification, description, options, accessories, specifications and other basic information.

1-3. Figure 1-1 shows the Hewlett-Packard Model 8444A Tracking Generator with accessories supplied.

1-4. The various sections in this manual provide information as follows:

SECTION II, INSTALLATION, provides information relative to incoming inspection, power requirements, mounting, packing and shipping, etc.

SECTION III, OPERATION, provides information relative to operating the instrument.

SECTION IV, PERFORMANCE TESTS, provides information required to ascertain that the instrument is performing in accordance with published specifications.

SECTION V, ADJUSTMENTS, provides information required to properly adjust and align the instrument after repairs are made.

SECTION VI, REPLACEABLE PARTS, provides ordering information for all replaceable parts and assemblies.

SECTION VII, MANUAL CHANGES, normally will contain no relevant information in the original issue of a manual. This section is reserved to provide back-dated and up-dated information in manual revisions or reprints.

SECTION VIII, SERVICE, includes all information required to service the instrument.

### 1-5. SAFETY CONSIDERATIONS

#### 1-6. General

1-7. This is an International Electrotechnical Commission Safety Class I instrument. This instrument has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic

Measuring Apparatus," and has been supplied in safe condition.

#### 1-8. Operation

1-9. BEFORE APPLYING POWER, make sure the instrument's ac input is set for the available ac line voltage, that the correct fuse is installed, and that all normal safety precautions have been taken.

#### 1-10. Service

1-11. Although the instrument has been designed in accordance with international safety standards, the information, cautions, and warnings in this manual must be followed to ensure safe operation and to keep the instrument safe. Service and adjustments should be performed only by qualified service personnel.

1-12. Adjustment or repair of the opened instrument with the ac power connected should be avoided as much as possible and, when inevitable, should be performed only by a skilled person who knows the hazard involved.

1-13. Capacitors inside the instrument may still be charged even though the instrument has been disconnected from its source of supply.

1-14. Make sure only fuses of the required current rating and type (normal blow, time delay, etc.) are used for replacement. Do not use repaired fuses or short circuit the fuse holders.

1-15. Whenever it is likely that the protection has been impaired, make the instrument inoperative and secure it against any unintended operation.

### WARNINGS

If this instrument is to be energized through an autotransformer (for voltage reduction), make sure the common terminal is connected to the earthed pole of the power source.

BEFORE SWITCHING ON THE INSTRUMENT, the protective earth terminals of the instrument must be connected to the protective conductor of the mains power cord. The mains plug shall only be inserted in a socket outlet provided with

protective earth contact. The protection must not be negated by using an extension cord (power cable) without a protective grounding conductor.

Interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal is likely to make this instrument dangerous. Intentional interruption of the earth ground is prohibited.

Servicing this instrument often requires that you work with the instrument's protective covers removed and with ac power connected. Be very careful; the energy at many points in the instrument may, if contacted, cause personal injury.

With the ac power cable connected, the ac line voltage is present at the terminals of the power line module and at the LINE power switch. Be very careful. Bodily contact with this voltage can be fatal.

#### CAUTIONS

BEFORE SWITCHING ON THIS INSTRUMENT, make sure instrument's ac input is set to the voltage of the ac power source.

BEFORE SWITCHING ON THIS INSTRUMENT, make sure that all devices connected to the instrument are connected to the protective earth ground.

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the ac line fuse is of the required current rating and type (normal-blow, time-delay, etc.).

## 1-16. INSTRUMENTS COVERED BY MANUAL

1-17. Hewlett-Packard instruments carry a serial number (see Figure 1-2) on the back panel. When

the serial number prefix on the instrument serial number plate of your instrument is the same as one of the prefix numbers on the inside title page of this manual, the manual applies directly to the instrument. When the instrument serial number prefix is not listed on the inside title page of initial issue, manual change sheets and manual up-dating information is provided. Later editions or revisions to the manual will contain the required change information in Section VII.

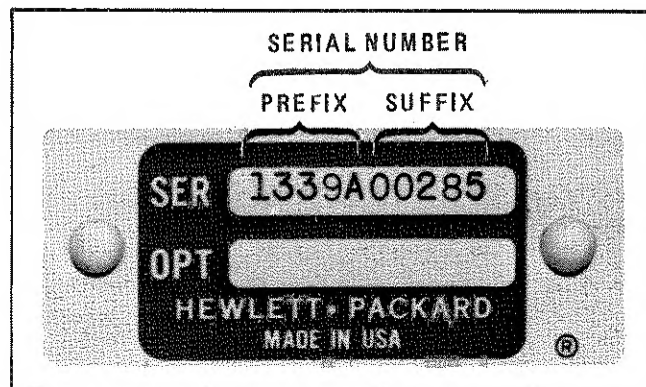


Figure 1-2. Instrument Identification

## 1-18. DESCRIPTION

1-19. The Model 8444A Tracking Generator is designed to complement both Model 8554B and Model 8555A Spectrum Analyzer RF Sections. The Tracking Generator covers the frequency range of 500 kHz to 1250 MHz when used with the 8554B RF Section and from 10 MHz to 1.3 GHz when used with the 8555A RF Section. The Tracking Generator/Spectrum Analyzer functions as a system to perform frequency response measurements. Additionally, the system can be used as a signal generator or sweeper to supply a test signal to other devices. An auxiliary output is provided for precision frequency measurements by an external frequency counter.

1-20. The Tracking Generator converts the first and third local oscillator (LO) signals from the Spectrum Analyzer RF Section, to a signal that tracks the frequency tuning of the RF Section. With the Spectrum Analyzer operating in ZERO SCAN WIDTH, the Tracking Generator is a CW signal generator, tuned to the frequency of the analyzer. In FULL or PER DIVISION SCAN WIDTH the Tracking Generator functions as a sweep oscillator which tracks the analyzer tuning. Additionally, a

Table 1-1. System Specifications

These system specifications describe the performance available from the spectrum analyzer-tracking generator system in various types of applications. In all cases it is assumed that the spectrum analyzer is equipped with either an 8554B or 8555A Tuning Section, 8552A or 8552B IF Section, 140T or 141T Display Section.

### SWEPT FREQUENCY RESPONSE MEASUREMENTS

The tracking generator is used as a signal source to measure the frequency response of a device.

**Dynamic Range:** > 90 dB from spectrum analyzer 1 dB gain compression point to average noise level (approximately -10 dBm to -100 dBm). Spurious responses not displayed.

**Gain Compression:** For -10 dBm signal level at the input mixer, gain compression < 1 dB.

**Average Noise Level:** > -102 dBm with 10 kHz IF bandwidth.

### Absolute Amplitude Calibration Range:

Spectrum Analyzer:

Log: From -122 dBm to +10 dBm, 10 dB/div on a 70 dB display or 2 dB/div on a 16 dB display (8552A has 10 dB/div only).

Linear: From 0.1  $\mu$ V/div to 100 mV/div (8555A), 20 mV/div (8554B) in a 1, 2 sequence on an 8-division display.

Tracking Generator (Drive Level to Test Device): 0 to -10 dBm continuously variable. 0 dBm calibrated to  $\pm 0.5$  dB at 30 MHz.

**Frequency Range:** 500 kHz to 1250 MHz with 8554B and 10 MHz to 1300 MHz with 8555A.

**Scan Width (Determined by Spectrum Analyzer Controls):**

Per Division: With 8555A, 16 calibrated scan widths from a 2 kHz/div to 200 MHz/div in a 2, 5, 10 sequence. With 8554B, 15 calibrated scan widths from a 2 kHz/div to 100 MHz/div in 2, 5, 10 sequence.

**Full Scan:** 0-1250 MHz with 8554B; 0-1300 MHz with 8555A.

**Zero Scan:** Analyzer is fixed tuned receiver.

**Frequency Resolution:** 1 kHz.

**Stability:**

Residual FM (peak to peak):

Tuning Section	Stabilized	Unstabilized
8554B/8555A	200 Hz	10 kHz

**Amplitude Accuracy:**

System Frequency Response:  $\pm 1.5$  dB.

Tracking Generator Calibration: 0 dBm at 30 MHz to  $\pm 0.5$  dB.

### SWEEP/CW GENERATOR

The tracking generator-spectrum analyzer system can be used to supply test signals for other devices as a sweeper.

**Frequency:** Controlled by spectrum analyzer. Range is 500 kHz to 1250 MHz with the 8554B and 10 MHz to 1300 MHz with the 8555A.

**Frequency Accuracy:**  $\pm 10$  MHz (8554B),  $\pm 15$  MHz (8555A) using spectrum analyzer tuning dial. Can be substantially improved using external counter output.

**Spectral Purity:**

Residual FM (peak-to-peak):

Tuning Section	Stabilized	Unstabilized
8554B/8555A	200 Hz	10 kHz

Harmonic Distortion: Typically 25 dB below output level.

Nonharmonic (spurious) Signals: > 35 dB below output level.

Flatness:  $\pm 0.5$  dB.

**Long Term Stability:** Drift typically less than 30 kHz/hour when stabilized after 2-hour warmup.

**Sweep Width:** 20 kHz to 1250 MHz (8554B) or 1300 MHz (8555A).

**Sweep Rates:** Selected by Scan Time per Division on spectrum analyzer. 16 internal scan rates from 0.1 msec/div to 10 sec/div in a 1, 2, 5 sequence. Manual Scan is available with the external sweep voltage from the 8444A or by a front panel control of the 8552B IF Section.

### PRECISION FREQUENCY MEASUREMENTS

An external counter output is provided on the 8444A for precision frequency measurements. The frequency of unknown signals as well as the frequency of any point on a frequency response curve can be measured. The use of the HP 5300A/5303A Counter is suggested for frequency measurements to 500 MHz and the HP 5245L/5254C Counter for measurements to 1300 MHz.

**Frequency Accuracy:**

For unknown signals  $\pm 10$  kHz. (Tracking drift typically 5 kHz/10 min after 2-hour warmup.)

For points on frequency response curve, counter accuracy  $\pm$  Residual FM.

**Counter Mode of Operation:**

Manual Scan: Scan determined either by front panel control of 8552B IF Section or by external scan signal provided by the 8444A.

Zero Scan: Analyzer is fixed tuned receiver. Counter reads center frequency to accuracy of tracking drift.

Counter Output Level: 0.1 V rms.

### GENERAL SPECIFICATIONS

**Temperature Range:** Operation, 0 to 55°C, storage -40°C to 75°C.

**Power:** 115V and 230V, 48 to 440 Hz, 12 watts max.

MANUAL SCAN control on the Tracking Generator allows manual tuning of the Spectrum Analyzer/Tracking Generator System. The amplitude of the Tracking Generator output is adjustable over a 0 to -10 dBm range by a front panel vernier control. The output level is calibrated at 30 MHz to 0  $\pm$  0.5 dBm and maintained by an automatic level control circuit. Refer to Table 1-1 for system performance specifications.

### 1-21 8554L RF SECTION MODIFICATIONS

1-22. Hewlett-Packard Model 8554L Spectrum Analyzer RF Section with serial prefixes 1101A and below require modification for Tracking Generator compatibility. The modification consists of adding two cables to the RF Section. The cables provide front panel access to the first and third LO outputs. The modification kit, HP Part Number 08554-60056, containing all necessary parts and information is available from any Hewlett-Packard Sales and Service Office. (A list of Sales and Service offices is contained in the back of this manual.) Service Note 8554L-6 containing the modification procedure is included with the modification kit. After modification, the Service Note should be filed with the 8554L Service Manual.

### 1-23. ACCESSORIES SUPPLIED

1-24. Accessories supplied with the Tracking Generator are listed in Table 1-2. RF cables, supplied with the Tracking Generator, allow operation with either the 8554B or 8555A Spectrum Analyzer RF Sections. The power cable, supplied with the instrument, is selected at time of shipment. Cable selection is based on shipping destina-

tion. Figure 2-1 illustrates the different power cable connectors that are currently available.

### 1-25. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1-26. In addition to the accessories supplied with the Tracking Generator, a Spectrum Analyzer System is required to complete the Tracking Generator Spectrum Analyzer System. The Tracking Generator is compatible with either the 8554B/8552( )/140-series Spectrum Analyzer System or the 8555A/8552( )/140-series Spectrum Analyzer System. Refer to paragraph 1-11 for modifications to early model Spectrum Analyzer Systems. For precision frequency measurements a frequency counter is required for use with the Tracking Generator/Spectrum Analyzer System. Operating accessories are listed in Table 1-4.

### 1-27. WARRANTY

1-28. The Hewlett-Packard Model 8444A Tracking Generator is warranted and certified as indicated on the inner front cover of this manual. For further information contact the nearest Hewlett-Packard Sales and Service office; addresses are provided at the back of this manual.

### 1-29. RECOMMENDED TEST EQUIPMENT

1-30. Table 1-3 lists the test equipment and accessories required to check, adjust, and repair the Tracking Generator. If substitute equipment is used, it must meet the Minimum Specifications listed in Table 1-3.

Table 1-2. Accessories Supplied

HP Part Number	Name	Description
8120-1348*	Line Power Cable	7½ feet, 3 wire AC Line Cord
5060-8739	Rack Mounting Kit	Hardware and parts for mounting instrument in 19-inch rack.
08444-60017	Interconnect Cable	Coaxial cable for interconnection between AUX "A" connector on Display Section and THIRD LO INPUT on Tracking Generator. For use with 8555A Spectrum Analyzer System.
08444-60018	Interconnect Cable	18-inch low leakage coaxial cable with BNC connectors. Three (3) each supplied. Two required for 8555A Spectrum Analyzer System. Three required for 8554B Spectrum Analyzer System. Connects FIRST LO to FIRST LO, THIRD LO to THIRD LO and SCAN OUTPUT to SCAN IN/OUT.
*See paragraph 2-15 and Figure 2-1.		



Table 1-3. Test Equipment and Accessories (1 of 3)

Item	Minimum Specifications	Suggested Model	Use*
Spectrum Analyzer System	Frequency Range: 500 kHz — 1.25 GHz Compatible with Tracking Generator (Part of System)	HP 8554B or 8555A/8552B 141T Spectrum Analyzer System	P,A,T
Frequency Comb Generator	Frequency markers spaced 100 MHz apart Frequency Accuracy: $\pm 0.01\%$ Output Amplitude: $-30$ dBm to 1.5 GHz	HP 8406A Comb Generator	P,T
Spectrum Analyzer System (Test Analyzer)	Frequency Range: 500 kHz — 4 GHz Amplitude Accuracy: $\pm 1$ dB	HP 8553B/8555A/8552B/ 141T Spectrum Analyzer System	P,A,T
Power Meter	Frequency Range: 0.01 — 12 GHz Accuracy: $\pm 1\%$ Power Range: $-20$ to $+10$ dBm	HP 432A Power Meter with HP 8478B Therm- istor Mount	P,A,T
AC Voltmeter	Frequency Range: 10 Hz to 10 MHz Voltage Range: 1 mV to 300V Calibration: $-10$ to $+2$ dB, 10 dB between ranges. Accuracy: $\pm 5\%$ at 10 MHz	HP 400E AC Voltmeter	P,A
AC Voltmeter	Voltage Accuracy: $\pm 3\%$ of full scale Voltage Range: 300V full scale Input Impedance: 10 megohms	HP 410C Multifunction Voltmeter	A, T
Frequency Counter	Frequency Range: 500 kHz — 50 MHz, 200 MHz — 3.0 GHz Frequency Accuracy: $\pm 0.01\%$	HP 5245L Frequency Counter with HP 5254C Frequency Converter	P,A,T
Test Oscillator	Frequency Range: 10 Hz — 10 MHz Frequency Accuracy: $\pm 3\%$ Output Amplitude: 3 Vrms Output Impedance: 50 ohms	HP 652A Test Oscillator	P,A
HF Signal Generator	Frequency Range: 1 — 50 MHz Output Amplitude: $> 0$ dBm Frequency Accuracy: $\pm 1\%$ Output Impedance: 50 ohms	HP 606A/B HF Signal Generator	P
VHF Signal Generator	Frequency Range: 50 — 450 MHz Output Amplitude: $> 0$ dBm Output Impedance: 50 ohms	HP 608E/F VHF Signal Generator	P
UHF Signal Generator	Frequency Range: 450 — 1200 MHz Output Amplitude: 0 dBm Output Impedance: 50 ohms	HP 612A UHF Signal Generator	P
Digital Voltmeter	Voltage Accuracy: $\pm 0.2\%$ Voltage Range: 1 — 30 Vdc Polarity: Automatic Indication	HP 3440A Digital Volt- meter w HP 3443A Plug-in	A,T
*P = Performance Test; A = Adjustments; T = Troubleshooting			

Table 1-3. Test Equipment and Accessories (2 of 3)

Item	Minimum Specifications	Suggested Model	Use*
Variable Voltage Transformer	Voltage Range: 102 — 127 Vac	General Radio W5MT3A or Superior Electric UC1M	A, T
Power Supply Dual Dc	Output Voltage: Variable 0 — 20 Vdc Output Current: 0 — 200 mA Meter Accuracy: $\pm 3\%$ Control: Fine adjustment	HP 6205B Power Supply	A, T
Dc Volt-Ohm-Ammeter	Voltmeter Voltage Range: 1 mV — 50 Vdc Accuracy: $\pm 1\%$ Input Resistance: 10 megohms Ammeter Current Range: 1 mA — 200 mA Accuracy: $\pm 2\%$ Ohmmeter Resistance Range: 1 ohm — 100 megohm Accuracy: $\pm 5\%$ reading at center scale	HP 412A Volt-Ohm Ammeter	A, T
Coaxial Attenuator	Frequency Range: DC — 4 GHz Flatness: $\pm 0.2$ dB	HP 8491A Option 10	A, T
Adapter	BNC Tee	UG-274B/U HP 1250-0781	P,A,T
Adapter	BNC Female to Type N Male	UG-201A/U HP 1250-0067	P,A,T
Cable Assembly	Coaxial cable with Male BNC connectors, 48 inches long	HP 10503A	P,A,T
Cable Assembly	Coaxial cable terminated with BNC Male connector and with probe and alligator clip	HP 10501A	A, T
Cable Assembly	Coaxial cable terminated with BNC Male connector and alligator clips	HP 10501A	A, T
Cable Assembly	Coaxial cable terminated with dual banana plug and probe with alligator clip	HP 11003A	A, T
Cable Assembly	Coaxial cable with dual banana plug and Male BNC connector terminations	HP 11001A	A, T
Cable Assembly	SMA Male to BNC Male	HP 08555-60076	A, T
Cable Assembly	Selectro Female to BNC Male Test Cable, 36 inches long	HP 11592-60001	A, T
Cable Assembly	Selectro Female to Selectro Male Test Cable, 8 inches long	HP 11592-60003	A, T
Adapter	BNC Jack to BNC Jack	UG-914A/U HP 1250-0080	A, T
*P = Performance Test; A = Adjustments; T = Troubleshooting			

Table 1-3. Test Equipment and Accessories (3 of 3)

Item	Minimum Specifications	Suggested Model	Use*
Wrench	Open-end, 5/16-inch	HP 8720-0030	A,T
Wrench	No. 10 Allen Driver	HP 5020-0291	A,T
Test Lead	Test lead with alligator clips	common	A,T
Resistor	100K ohm, 5%, 1 watt	HP 0757-0367 (1%)	A,T
Wrench	Open-end, 15/64-inch	HP 8710-0946	T
Low-pass Filter	700 MHz Cut-off	HP 360A	T
*P = Performance Test; A = Adjustments; T = Troubleshooting			

Table 1-4. Operating Accessories

Model Number	Name	Description
HP 8554B	RF Section	Spectrum Analyzer RF Section with frequency range of 500 kHz to 1250 MHz.
HP 8555A	RF Section	Spectrum Analyzer RF Section with frequency range of .01 to 18 GHz. When used with Tracking Generator, covers frequency range of 10 to 1300 MHz.
HP 140T	Display Section	Spectrum Analyzer Display Section compatible with Tracking Generator.
HP 141T	Display Section	Spectrum Analyzer Display Section with storage CRT display capability. Compatible with Tracking Generator.
HP 8552A	IF Section	Spectrum Analyzer IF Section compatible with Tracking Generator, 10 dB per division log range.
HP 8552B	IF Section	Spectrum Analyzer IF Section compatible with Tracking Generator, 2 dB per division log range.
HP 5300A/ 5303A	Frequency Counter	For precision frequency measurements to 500 MHz.
HP 5245L/ 5254C	Frequency Counter	For precision frequency measurements over frequency range of 0 to 50 MHz and 150 to 3000 MHz.
HP 5060-8543	Joining Bracket Kit	Hardware and parts for strapping Tracking Generator to Spectrum Analyzer. Provides a common ground and secure mounting.
HP 8120-1575	Accessory Power Cord	For accessory instrument operation off of line input to Tracking Generator. Plugs mate with accessory outlet connector and line input connector on HP 5060-1189 power line module.
HP 8120-1576	Accessory Power Cord	For accessory instrument operation off of line input to Tracking Generator. Plugs mate with accessory outlet connector and line input connector HP 1251-0148 (old type).



## SECTION II INSTALLATION

### 2-1. INITIAL INSPECTION

#### 2-2. Mechanical Check

2-3. Check the shipping carton for evidence of damage immediately after receipt. If there is any visible damage to the carton, request the carrier's agent be present when the instrument is unpacked. Inspect the instrument for physical damage such as bent or broken parts and dents or scratches. If damage is found refer to paragraph 2-6 for recommended claim procedures. If the instrument appears to be undamaged, perform the electrical check (see paragraph 2-4). The packaging material should be retained for possible future use.

#### 2-4. Electrical Check

2-5. The electrical check consists of following the performance test procedures listed in Section IV. These procedures allow the operator to determine that the instrument is, or is not, operating within the specifications listed in Table 1-1. The initial performance and accuracy of the instrument are certified as stated on the inside front cover of this manual. If the instrument does not operate as specified, refer to paragraph 2-6 for the recommended claim procedure.

### 2-6. CLAIMS FOR DAMAGE

2-7. If physical damage is found when the instrument is unpacked, notify the carrier and the nearest Hewlett-Packard Sales and Service office immediately. The Sales and Service office will arrange for repair or replacement without waiting for a claim to be settled with the carrier.

2-8. The warranty statement for the instrument is on the inside front cover of this manual. Contact the nearest Sales and Service office for information about warranty claims.

### 2-9. PREPARATION FOR USE

#### CAUTION

Before applying power, check the power selector switch on the Tracking Generator input power module (rear panel) for proper position (115 or 230 volts).

### 2-10. Power Requirements

2-11. The Tracking Generator can be operated from a 48- to 440-hertz input line that supplies either 115- or 230-volt ( $\pm 10\%$  in each case) power. Consumed power is normally less than 15 watts.

2-12. The 115/230 power selector switch on the rear panel line power module must be set to agree with the available line voltage. The selector switch is located below the fuse holder and fuse extractor lever. An arrow on the selector switch points to callouts listing the line input voltage and fuse amperage rating. To change the position of the selector switch it is necessary to remove the power cable, slide the protective cover to the left and lift the fuse extractor before the switch can be changed. With the fuse extractor extended, press down and toward the desired direction. Replace fuse with a fuse of the amperage rating for the selected position. See Section VI for replacement HP Part Numbers. The instrument is normally shipped with fuse installed for 115-volt operation.

### 2-13. Power Cable

2-14. To protect operating personnel, the National Electrical Manufacturers Association (NEMA) and the International Electrotechnical Commission (IEC) recommends that the instrument panel and cabinet be grounded. The Tracking Generator is equipped with a three-conductor power cable; the third conductor is the ground conductor and when the cable is plugged into an appropriate receptacle, the instrument is grounded. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green or green/yellow lead on the adapter to ground.

2-15. Power cables are selected for shipment with each instrument; with a line connector plug to match the standard power cord for the country of destination on the purchase order. A label indicating the power cable inside is affixed to the packing case. Figure 2-1 indicates the connector plugs and the HP part numbers for the various available power cables and plugs.

### 2-16. OPERATING ENVIRONMENT

2-17. The Tracking Generator does not require forced air cooling when operating at temperatures from 0 to 55°C (32 to 131°F). When operating the instrument, choose a location which will provide at

least three inches of clearance around the rear and both sides. Normal air circulation will maintain a reasonable temperature within the instrument.

## 2-18. INSTALLATION CONNECTIONS

2-19. A rack mounting kit is supplied for rack installation. Additionally, a joining bracket kit (accessory) can be provided to secure the Tracking Generator to the Spectrum Analyzer. Installation instructions are supplied with both joining bracket and rack mounting kits.

2-20. Electrical connections are provided by three coaxial cables and two line power cords. Coaxial cables connect Spectrum Analyzer FIRST LO OUTPUT to Tracking Generator FIRST LO INPUT, THIRD LO OUTPUT to THIRD LO INPUT and SCAN OUTPUT to SCAN IN/OUT. Double shielded coaxial cables are provided for connection between local oscillator input and output connectors. Refer to Table 1-2 for description and HP part number of cables supplied with the Tracking Generator.

## 2-21. STORAGE AND SHIPMENT

### 2-22. Original Packaging

2-23. The same containers and materials used in factory packaging can be obtained through the Hewlett-Packard Sales and Service offices listed at the rear of this manual.

2-24. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicat-

ing service required, return address, instrument model number and full serial number. Mark the container FRAGILE to assure careful handling.

2-25. In any correspondence refer to the instrument by model number and full serial number.

### 2-26. Other Packaging Materials

2-27. The following general instructions should be followed when repackaging with commercially available materials:

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard Service office or center attach a tag indicating the type of service required, return address, model number and full serial number.)

b. Use a strong shipping container. A double-wall carton made of 350 pound test material is adequate.

c. Use enough shock-absorbing material (three to four inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

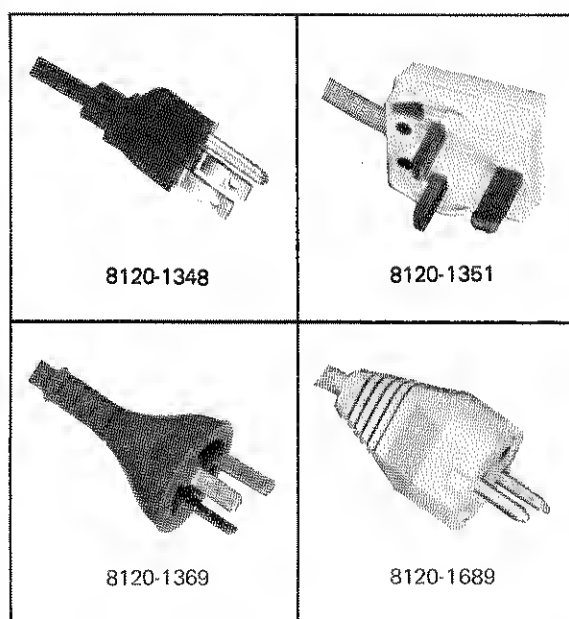


Figure 2-1. Power Cable Line Connector Labels

## SECTION III OPERATION

### 3-1. INTRODUCTION

3-2. This section provides complete operation instructions for the HP Model 8444A Tracking Generator. Front and rear panel controls, connectors and indicators for the Tracking Generator are identified and described in Figures 3-1 and 3-2. Operational connections and adjustments for the Tracking Generator and an 8554B Spectrum Analyzer System are detailed in Figure 3-3. Operational connections and adjustments for the Tracking Generator and an 8555A Spectrum Analyzer System are detailed in Figure 3-4. Additional operating information is contained in Figures 3-5 through 3-10.

### 3-3. PANEL FEATURES

3-4. Front and rear panel features of the Tracking Generator are described in Figures 3-1 and 3-2. Front and rear panel views of the Tracking Generator connected to the HP 8554B/8552/141T Spectrum Analyzer are shown in Figure 3-3. Front and rear panel views of the Tracking Generator connected to the HP 8555A/8552/141T Spectrum Analyzer are shown in Figure 3-4. For a detailed description of the Spectrum Analyzer controls, connectors and indicators refer to the appropriate operating and service manuals for those instruments. Interconnection wiring between the Tracking Generator and the Spectrum Analyzer is contained in Section VIII (Service Sheet 1) of this manual.

### 3-5. OPERATOR'S CHECKS

3-6. Upon receipt of the instrument, or when the Tracking Generator is to be used with a different Spectrum Analyzer, perform the operational adjustment procedures listed in Figure 3-3 or 3-4.

### 3-7. OPERATING INSTRUCTIONS

3-8. General operating instructions are contained in Figures 3-3 and 3-4. These instructions will familiarize the operator with basic operating functions of the Tracking Generator in use with Spectrum Analyzers. Additional operating techniques and information is contained in Figures 3-5 through 3-10.

### 3-9. CONTROLS, INDICATORS AND CONNECTORS

3-10. Front and rear panel controls, indicators and connectors are identified and briefly described in Figures 3-1 and 3-2. Operational adjustment procedures are given in Figures 3-3 and 3-4. Additional information, to assist the user during instrument operation, is given in the following paragraphs.

### 3-11. OPERATING TECHNIQUES

3-12. The following information is provided to acquaint the user with Tracking Generator/Spectrum Analyzer operation. When a device is placed in the signal path between the Tracking Generator and the Spectrum Analyzer, the analyzer detects and displays the frequency response of the device under test. The Spectrum Analyzer tuning and scan width settings determine the Tracking Generator output frequency and the resultant CRT display. The type of device, control settings, and typical display is provided for each of the following measurements.

- a. Crystal Filter Measurement, Para. 3-13.
- b. Bandpass Filter Measurement, Para. 3-15.
- c. Low-Pass Filter Measurement, Para. 3-17.
- d. Swept Return Loss Measurement, Para. 3-19.
- e. Amplifier Gain and Bandwidth Measurement, Para. 3-21.
- f. Precision Frequency Measurement, Para. 3-23.

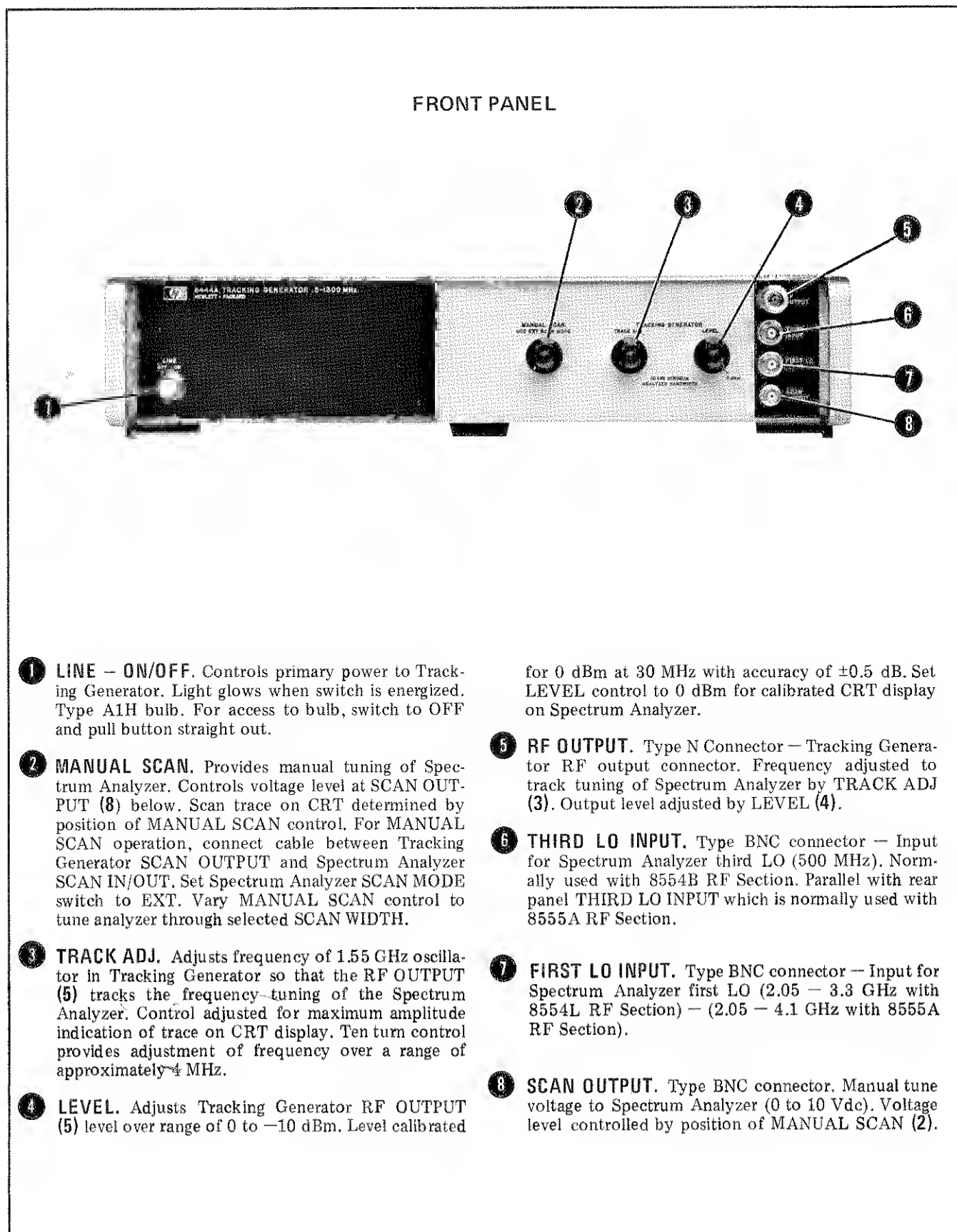


Figure 3-1. Model 8444A Tracking Generator Front Panel Controls, Indicators and Connectors



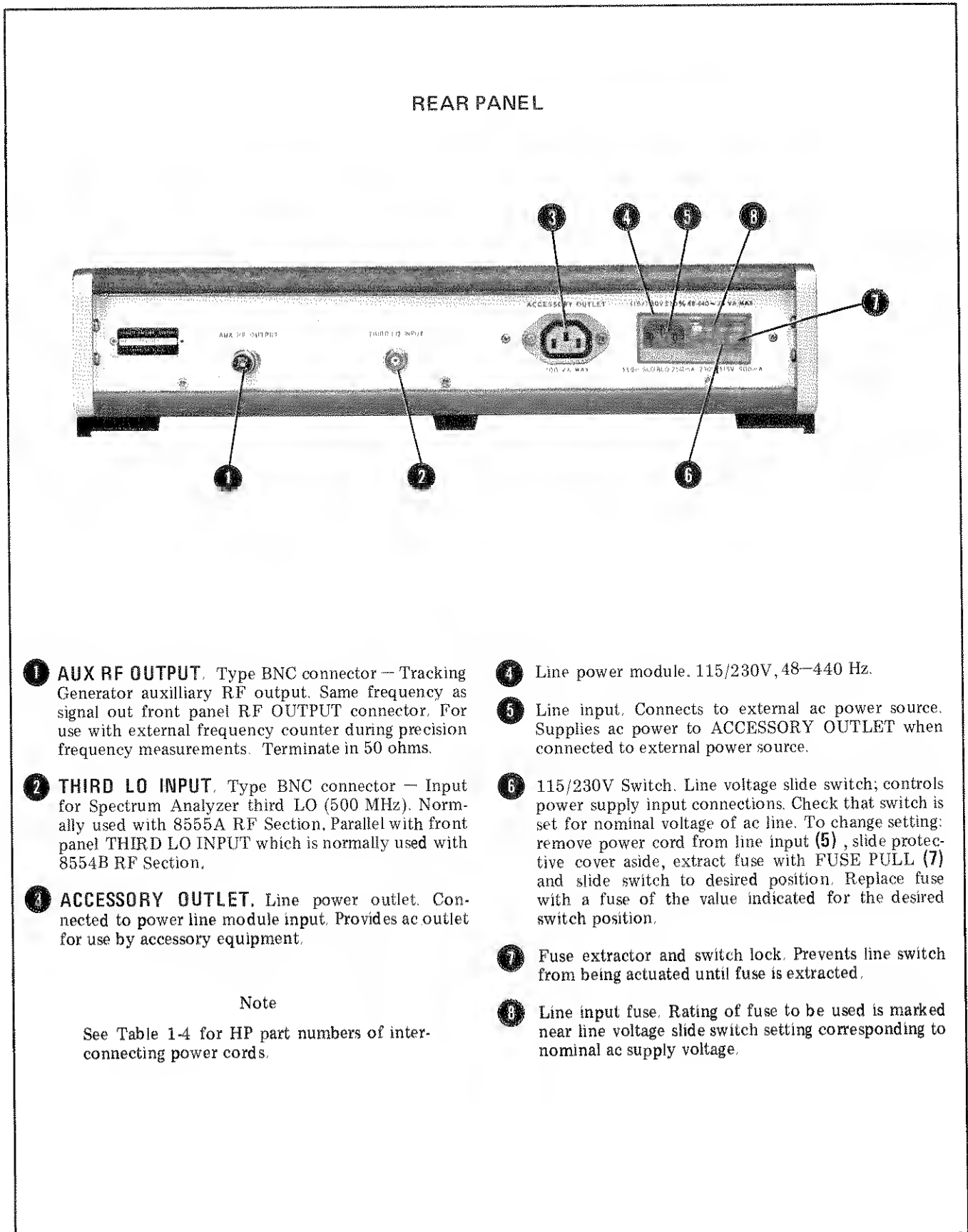


Figure 3-2. Model 8444A Tracking Generator Rear Panel Controls and Connectors

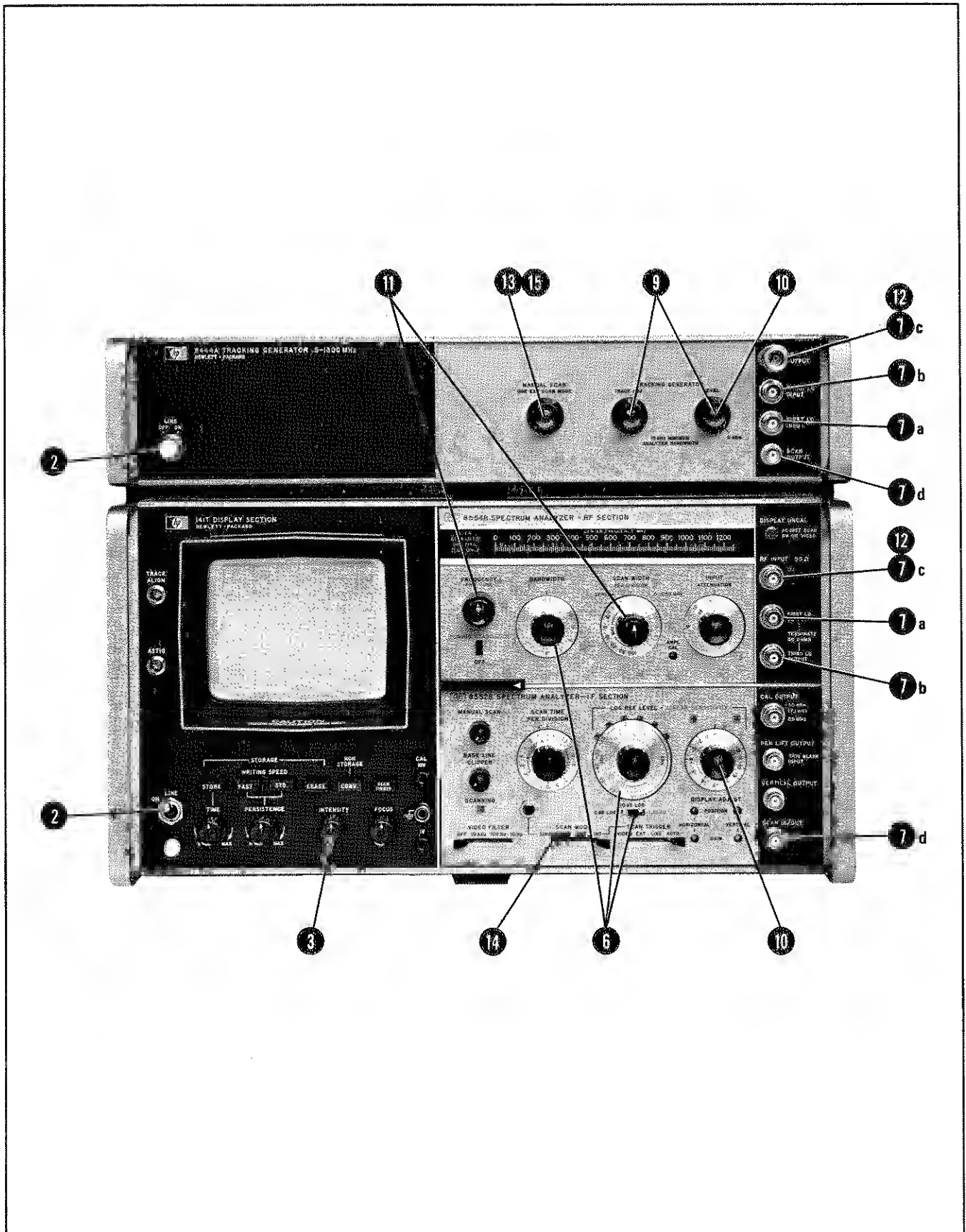


Figure 3-3. Tracking Generator Operation with 8554B Spectrum Analyzer (1 of 2)

### OPERATING PROCEDURE WITH AN 8554B

1. Check that the 115/230V switch is set to correspond with the available line voltage. Refer to Figure 3-2, steps 4 through 8, for switch and fuse information.
2. Apply power to Tracking Generator and Spectrum Analyzer.
3. Turn Spectrum Analyzer INTENSITY control fully CCW.
4. Allow instruments to warm up for at least 30 minutes.
5. Perform Spectrum Analyzer "Calibration Procedure". Refer to 8554B RF Section Operating Manual.
6. Set Spectrum Analyzer LOG/LINEAR control to LOG, LOG REF LEVEL to 0 dBm, and BANDWIDTH to 300 kHz.
7. Make the following interconnections between Tracking Generator and Spectrum Analyzer:
  - a. FIRST LO INPUT to FIRST LO OUTPUT.
  - b. THIRD LO INPUT to THIRD LO OUTPUT.
  - c. RF OUTPUT to RF INPUT.
  - d. SCAN OUTPUT to SCAN IN/OUT.
8. Check that the Spectrum Analyzer controls are set as follows:
 

INTENSITY .....	12 o'clock (approx.)
FREQUENCY .....	30 MHz
BANDWIDTH .....	300 kHz
SCAN WIDTH PER DIVISION .....	50 kHz
INPUT ATTENUATION .....	10 dB
TUNING STABILIZER .....	On
BASE LINE CLIPPER .....	CCW
SCAN TIME PER DIVISION .....	5 MILLISECONDS
9. Set Tracking Generator LEVEL control to 0 dBm and adjust TRACK ADJ for maximum signal amplitude indication on CRT display.
10. Adjust Spectrum Analyzer Vernier control or Tracking Generator LEVEL control to position signal on CRT LOG REF level graticule line. (System calibrated at 30 MHz with an amplitude accuracy of  $\pm 0.5$  dB.)
11. Set Spectrum Analyzer to scan desired frequency range. (FREQUENCY control adjusted to center of frequency of interest, SCAN WIDTH set for desired coverage.)
12. Insert device to be tested between Tracking Generator RF OUTPUT and Spectrum Analyzer RF INPUT.
13. Rotate Tracking Generator MANUAL SCAN control fully counterclockwise.
14. Set Spectrum Analyzer SCAN MODE switch to EXT.
15. Rotate Tracking Generator MANUAL SCAN control clockwise to tune system through selected frequency range.
16. For automatic scanning, set SCAN MODE switch to INT and SCAN TIME PER DIVISION to desired scan time.

LOG/LINEAR ..... LOG  
 LOG REF LEVEL ..... 0 dBm  
 LOG REF LEVEL Vernier ..... 0  
 VIDEO FILTER ..... OFF  
 SCAN MODE ..... INT  
 SCAN TRIGGER ..... LINE

Figure 3-3. Tracking Generator Operation with 8554B Spectrum Analyzer (2 of 2)

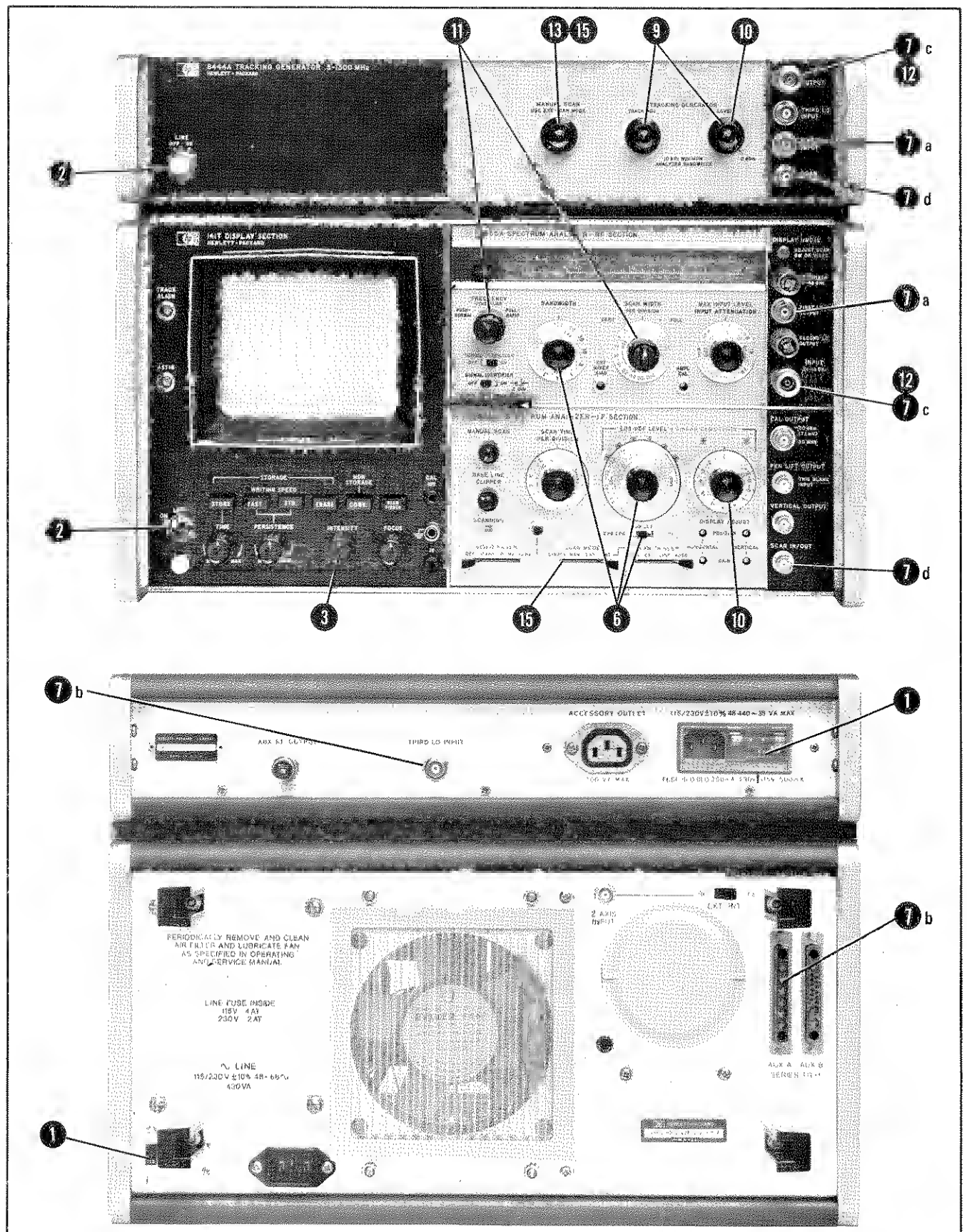


Figure 3-4. Tracking Generator Operation with 8555A Spectrum Analyzer (1 of 2)

### OPERATING PROCEDURE WITH AN 8555A

1. Check that the 115/230 switch is set to correspond with the available line voltage. Refer to Figure 3-2, steps 4 through 8, for switch and fuse information.
2. Apply power to Tracking Generator and Spectrum Analyzer.
3. Turn Spectrum Analyzer INTENSITY control fully CCW.
4. Allow instruments to warm up for at least 30 minutes.
5. Perform Spectrum Analyzer Operational Adjustments (30 MHz Calibration). Refer to 8555A RF Section Operating and Service Manual.
6. Set Spectrum Analyzer LOG/LINEAR control to LOG, LOG REF LEVEL to 0 dBm, and BANDWIDTH to 300 kHz.
7. Make the following interconnections between Tracking Generator and Spectrum Analyzer:
  - a. FIRST LO INPUT to FIRST LO OUTPUT.
  - b. THIRD LO INPUT to THIRD LO OUTPUT (rear panel connections).
  - c. RF OUTPUT to INPUT.
  - d. SCAN OUTPUT to SCAN IN/OUT.
8. Check that the Spectrum Analyzer controls are set as follows:
 

INTENSITY .....	12 o'clock (approx.)
BAND .....	n=1— (2.05 GHz IF)
FREQUENCY .....	30 MHz
BANDWIDTH .....	300 kHz
SCAN WIDTH PER DIVISION .....	100 kHz
INPUT ATTENUATION .....	20 dB
TUNING STABILIZER .....	ON
SIGNAL IDENTIFIER .....	OFF
BASE LINE CLIPPER .....	CCW
SCAN TIME PER DIVISION ....	10 MILLISECONDS
9. Set Tracking Generator LEVEL control to 0 dBm and adjust TRACK ADJ for maximum signal amplitude indication on CRT display.
10. Adjust Spectrum Analyzer Vernier control or Tracking Generator LEVEL control to position signal on CRT LOG REF level graticule line. (System calibrated at 30 MHz with an amplitude accuracy of  $\pm 0.5$  dB.)
11. Set Spectrum Analyzer to scan desired frequency range. (FREQUENCY control adjusted to center of frequency of interest, SCAN WIDTH set for desired coverage.)
12. Insert device to be tested between Tracking Generator RF OUTPUT and Spectrum Analyzer RF INPUT.
13. Rotate Tracking Generator MANUAL SCAN control fully counterclockwise.
14. Set Spectrum Analyzer SCAN MODE switch to EXT.
15. Rotate Tracking Generator MANUAL SCAN control clockwise to tune system through selected frequency range.
16. For automatic scanning, set SCAN MODE switch to INT and SCAN TIME PER DIVISION to desired scan time.

LOG/LINEAR .....	LOG
LOG REF LEVEL .....	0 dBm
LOG REF LEVEL Vernier .....	0
VIDEO FILTER .....	OFF
SCAN MODE .....	INT
SCAN TRIGGER .....	LINE or AUTO

Figure 3-4. Tracking Generator Operation with 8555A Spectrum Analyzer (2 of 2)

### 3-13. Crystal Filter Measurement

3-14. Figure 3-5 illustrates the CRT display for a 20 MHz crystal filter. Filter characteristics: 2-kHz passband with bandwidth at the 60-dB points less than 10 kHz.

a. Spectrum Analyzer (8555A) control settings:

FREQUENCY ..... 20 MHz  
 BANDWIDTH ..... 3 kHz  
 SCAN WIDTH PER DIVISION ..... 5 kHz  
 INPUT ATTENUATION ..... 10 dB  
 SCAN TIME PER DIVISION 20 MILLISECONDS  
 LOG REF LEVEL ..... 0 dBm  
 VIDEO FILTER ..... 100 Hz  
 SCAN MODE ..... INT  
 SCAN TRIGGER ..... AUTO  
 LOG/LINEAR ..... LOG

b. Tracking Generator control settings:

TRACK ADJ ..... Peak  
 LEVEL ..... 0 dBm

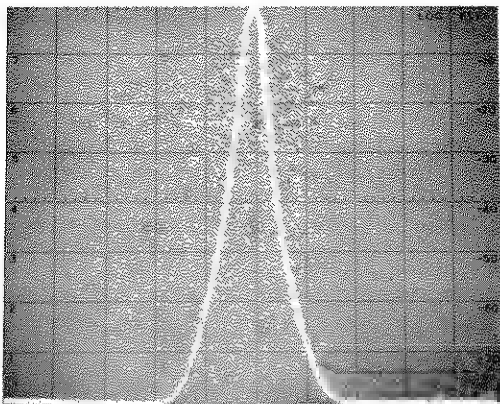


Figure 3-5. 20 MHz Crystal Filter CRT Display

### 3-15. Bandpass Filter Measurement

3-16. Figure 3-6 illustrates the CRT display for a 50 MHz bandpass filter. Filter characteristics: 50 MHz, 4-pole bandpass filter; adjusted for bandwidth of approximately 5 MHz at the 3 dB points. Bandwidth at 60 dB points is approximately 32 MHz.

a. Spectrum Analyzer (8555A) control settings:

FREQUENCY ..... 50 MHz  
 BANDWIDTH ..... 10 kHz  
 SCAN WIDTH PER DIVISION ..... 5 MHz  
 INPUT ATTENUATION ..... 10 dB

SCAN TIME PER DIVISION ..... 0.5 SECONDS  
 LOG REF LEVEL ..... 0 dBm  
 VIDEO FILTER ..... 10 Hz  
 SCAN MODE ..... INT  
 SCAN TRIGGER ..... AUTO  
 LOG/LINEAR ..... LOG

b. Tracking Generator control settings:

TRACK ADJ ..... Peak  
 LEVEL ..... 0 dBm

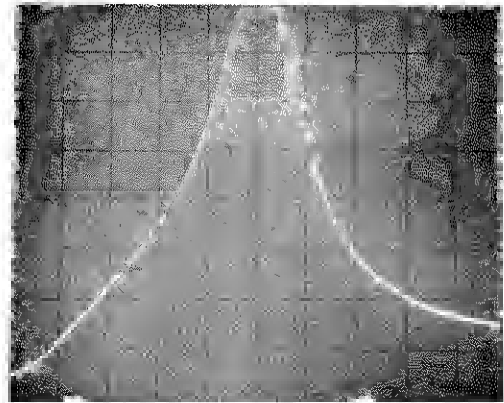


Figure 3-6. 50 MHz Bandpass Filter CRT Display

### 3-17. Low-Pass Filter Measurement

3-18. Figure 3-7 illustrates the CRT display for a 23 MHz low-pass filter. Filter characteristics: 3 dB point at approximately 23 MHz, 60 dB point at approximately 42 MHz.

a. Spectrum Analyzer (8555A) control settings:

FREQUENCY ..... 25 MHz  
 SCAN WIDTH PER DIVISION ..... 5 MHz  
 BANDWIDTH ..... 100 kHz  
 INPUT ATTENUATION ..... 10 dB  
 SCAN TIME PER DIVISION ..... 0.1 SECONDS  
 LOG/LINEAR ..... LOG  
 LOG REF LEVEL ..... (+) 10 dBm  
 LOG REF LEVEL Vernier ..... -3 dB  
 VIDEO FILTER ..... 10 Hz  
 SCAN MODE ..... INT  
 SCAN TRIGGER ..... AUTO

b. Tracking Generator control settings:

TRACK ADJ ..... Peak  
 LEVEL ..... 0 dBm



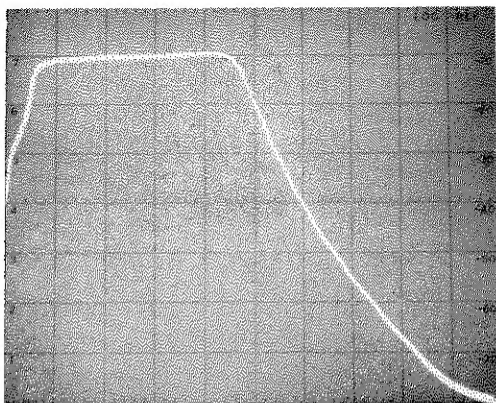


Figure 3-7. 23 MHz Low-Pass Filter CRT Display

### 3-19. Swept Return Loss Measurement

3-20. Figure 3-8 illustrates the CRT display for a swept return loss or reflection coefficient measurement. A directional bridge (HP 8721A) was used to separate the incident from the reflected signal. The filter under test is the same 23-MHz Low-Pass (paragraph 3-18). Control settings same as paragraph 3-18 except analyzer gain adjusted so that the top graticule line represents 0 dB return loss or total reflection (e.g. a short or open circuit). Return loss is greater than 15 dB ( $\rho$  0.18, SWR 1.44) over the filter range of 0 to 23 MHz.

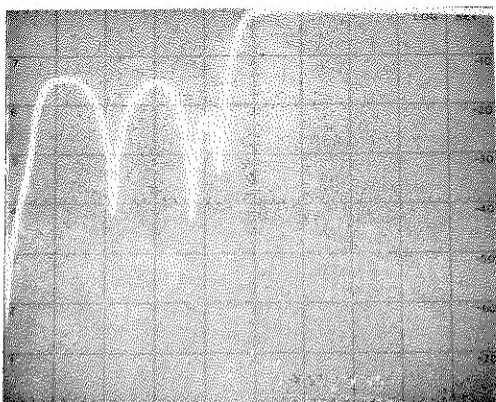


Figure 3-8. Swept Return Loss Measurement CRT Display

### 3-21. Amplifier Gain and Bandwidth Measurement

3-22. Figure 3-9 illustrates the CRT display for a .1 to 400 MHz amplifier with gain of approximately 19 dB. A reference level is first established by connecting the Tracking Generator output to the Spectrum Analyzer (through a 30 dB attenuator) and scanning over the range of interest. The amplifier is then connected between the Tracking Generator and the Spectrum Analyzer and the same

frequency range scanned. The Spectrum Analyzer (8554B) set to full scan (0–1250) provides a CRT display indication as follows: 3-dB bandwidth approximately 500 MHz (level at +1 graticule line) and zero gain point of approximately 1025 MHz.

a. 30 dB Coaxial Attenuator installed at Tracking Generator RF OUTPUT.

b. Spectrum Analyzer (8554B) control settings:

BANDWIDTH .....	300 kHz
SCAN WIDTH .....	0–1250 MHz
INPUT ATTENUATION .....	10 dB
SCAN TIME PER DIVISION	10 MILLISECONDS
LOG/LINEAR .....	LOG
LOG REF LEVEL .....	+10 dBm
VIDEO FILTER .....	OFF
SCAN MODE .....	INT
SCAN TRIGGER .....	AUTO

c. Tracking Generator control settings:

TRACK ADJ .....	Peak
LEVEL .....	0 dBm

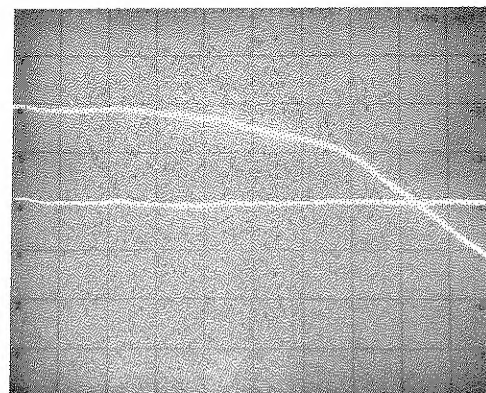


Figure 3-9. Amplifier Gain and Bandwidth CRT Display

### 3-23. Precision Frequency Measurements

3-24. An external frequency counter may be used with the Tracking Generator/Spectrum Analyzer System for frequency measurements at any point on the CRT display. With the counter connected to the Tracking Generator AUX RF OUTPUT jack (rear panel) and the system operated in the MANUAL SCAN mode; the scan can be stopped at any point for frequency measurement.

#### CAUTION

Do not leave System stopped in MANUAL SCAN with high INTENSITY. Damage to the display CRT can result.

Figure 3-10 illustrates frequency measurement at the 30 dB point on a low-pass filter.

a. Spectrum Analyzer (8554B) control settings:

FREQUENCY ..... 50 MHz  
 BANDWIDTH ..... 300 kHz  
 SCAN WIDTH PER DIVISION ..... 10 MHz  
 INPUT ATTENUATION ..... 10 dB  
 SCAN TIME PER DIVISION 10 MILLISECONDS  
 LOG REF LEVEL ..... 0 dBm  
 LOG/LINEAR ..... LOG  
 VIDEO FILTER ..... OFF  
 SCAN MODE ..... INT  
 SCAN TRIGGER ..... AUTO

b. Tracking Generator control settings:

TRACK ADJ ..... Peak  
 LEVEL ..... 0 dBm  
 MANUAL SCAN ..... CCW

c. Connect unit under test between Tracking Generator RF OUTPUT and Spectrum Analyzer RF INPUT.

d. Connect Tracking Generator AUX RF OUTPUT to Frequency Counter input.

e. Connect Tracking Generator SCAN OUTPUT to Spectrum Analyzer SCAN IN/OUT.

f. Connect Tracking Generator FIRST LO INPUT to Spectrum Analyzer FIRST LO OUTPUT and THIRD LO INPUT to THIRD LO OUTPUT.

g. Note point of interest on CRT display.

h. Set Spectrum Analyzer SCAN MODE to EXT and rotate Tracking Generator MANUAL SCAN control clockwise to point of interest.

i. Note and record frequency.

j. Set Spectrum Analyzer SCAN MODE to INT.

#### Note

The CRT trace (dot) can be moved in either direction by the Tracking Generator MANUAL SCAN control. For best frequency accuracy, approach frequency measurement point while tuning the MANUAL SCAN control in the clockwise direction.

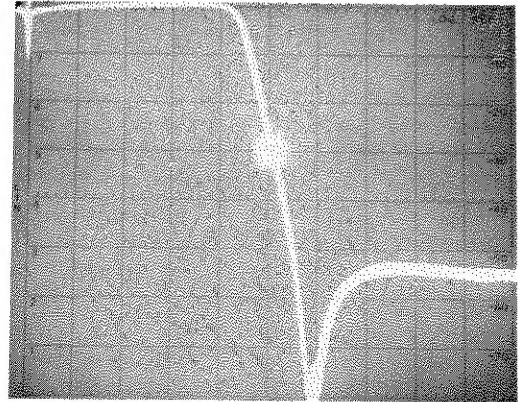


Figure 3-10. Precision Frequency Measurement CRT Display





